subject, the nervous control of pupillary movements. A review of the work done on the question of the course of the pupillo-dilator fibres is given. These fibres pass from the cervical sympathetic as a separate tract along the carotid towards the Gasserian ganglion, and run thence with the ophthalmic division of the trigeminal along the nasal branch to the long ciliary nerves, thus avoiding the ciliary ganglion. The final portion of the lecture is devoted to a discussion of the cortical localisation of pupillary movements. We agree with Mr. Parsons that a very critical spirit is necessary in dealing with this subject. Here, more than anywhere else, is to be found the "elusive factor" which upsets all hypotheses. The term "synkinesis" seems to have a sufficiently useful application in neurological nomenclature to justify its invention. The limits of this notice do not allow of more detailed criticism. We must, however, congratulate Mr. Parsons on the singularly lucid, though necessarily inconclusive, fashion in which he has dealt with subjects of great complexity and importance.

The Twentieth Century Atlas of Microscopical Petrography. Part ii. With four plates. (London: Thos. Murby, 1904.)

SINCE the note on this work appeared in NATURE (vol. lxxi. p. 38), we have been informed that the "editor" of it is Mr. E. Howard Adye, who is, in fact, responsible both for the text and for the very delicate plates. The second part includes two igneous rocks from Edinburgh, the Carboniferous oolite of Clifton, and the beautiful green quartzite of Ightham, described by Prof. Bonney in 1888. This last rock, we believe, usually contains altered glauconite in addition to the minerals mentioned by the author. We fancy that Mr. Adye is familiar with biological writing, which makes his descriptions rather more severely technical than is customary among English geologists. We thus read of a "dark brown fenestrated region at the periphery," "hypo-odontoid outgrowths," "biogenetic formation," and so forth. We do not know, moreover, what degree of extraordinary accuracy is suggested by the phrases "completely polarised light" and "fully-crossed Nicols." The text, however, is usually clear and graphic. The four rock-sections accompanying the part, and issued through the laboratory of Mr. J. R. Gregory, are absolutely perfect specimens of an art rarely cultivated in the British Isles. G. A. J. C.

Abbildungen der in Deutschland und den angrenzenden Gebieten vorkommenden Grundformen der Orchideen-arten. 60 Tafeln nach der Natur gemalt und in Farbendruck ausgefuhrt von Walter Müller (Gera) mit beschreiben dem Text von Dr. F. Kränzlin (Berlin). Pp. xiv+60+plates. (Berlin: R. Friedländer und Sohn, 1904.) Price 10 marks.

THIS is a series of sixty coloured plates representing the orchids which occur in Central Europe. The introduction and the text are from the pen of Dr. Kränzlin, who tells us at the outset that the book is not intended for professed botanists, but for those who take an interest in botany, or who possess a love of flowers. For this reason it is, we suppose, that the minutiæ of anatomical structure and the details of physiology are but lightly touched on. The reader, however, has put before him in a very clear way the principal points in the morphology of this most interesting group, together with an account of the conformation of each species.

A general statement is made as to the geographical distribution of the several plants, but no precise indications of particular localities are given. Most of our European orchids are terrestrial and have tuberous roots, but *Liparis Loeselii,* a species very rare in Britain, has a distinct pseudo-bulb such as characterises most of the tropical epiphytes of this order, and a similar form of stem occurs in *Microstylis monophyllos,* so that the formation of a pseudo-bulb is not correlated solely with the epiphytic habit. Both the tuber and the pseudo-bulb serve as food stores for the growing plant. In *Goodyera repens* there is a creeping underground stem which also recalls that of its tropical congeners. These points and others of a similar character are well represented in the plates. These illustrations were executed from life by Mr. Walter Müller, and they are so truthful that we may commend them to the notice of orchid lovers. Our field botanists will find all the British species represented, as well as a few others that are not members of the British Flora.

Intensification and Reduction. By Henry W. Bennett. Pp. xv+124. (London: Iliffe and Sons, Ltd., 1904.)

THIS issue, No. 15 of the *Photography* Bookshelf Series, will form a useful addition to an already valuable set of handbooks. The author has wisely restricted himself to setting forth in a clear and concise manner the better methods employed in intensification and reduction, and has not burdened the beginner with an elaborate index to all possible methods past and present. The processes dealt with are treated in some detail, so for this reason the reader should gain a good working knowledge of the manipulations he has in hand. The distinctive qualities of each method are clearly brought out, making the selection of any one for a particular negative quite an easy matter.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Slow Transformation Products of Radium.

IN a recent number of the *Philosophical Magazine* (November, 1904), I have shown that radium, after passing through four rapid changes, finally gives rise to two slow transformation products, which, on the scheme of changes there outlined, were called radium D and radium E.

These two products can be separated from each other by suitable physical and chemical methods. Radium D, which is the parent of E, gives out only β rays, while E gives out only α rays. It was calculated that D should be half transformed in forty years, and E in about one year. Evidence was also shown that radium D was the active constituent in the radio-active lead of Hofmann, and that radium E was the active substance present in both the polonium of Mme. Curie and the radio-tellurium of Marckwald.

Later work has confirmed these conclusions. I have examined the rates of decay of the activity of radium E and of radio-tellurium, and have found them to be identical. Each loses half its activity in about 150 days, instead of the calculated period of one year. The specimen of radio-tellurium was obtained from Sthamer, of Hamburg, in the form of a thin film deposited on a polished bismuth rod. I find that the same value for the decay and activity of radio-tellurium has recently been obtained by Meyer and Schweidler (*Akad. d. Wiss. Wien.,* December 1, 1904).

I was, unfortunately, unable at the same time to determine accurately the decay of the activity of polonium. A specimen of polonium (ratio-active bismuth) had been in my possession for three years, and had during that time lost a

large proportion of its original activity. On testing it, the activity was found to have reached a small and nearly constant value. Rough observations, however, which I had made from time to time indicated that the rate of decay of this polonium was certainly not very different from that of radium E. More accurate experiments will be required to settle the question definitely, but I think there is little doubt but that their rates of decay will be found to be the same.

Polonium, radio-tellurium, and radium E have very similar radio-active and chemical properties. Each gives out only α rays, and each is deposited on a bismuth plate placed in the active solution. The probable identity of their rates of decay, taken into conjunction with the similarity of their radiations and chemical properties, shows that the radio-active constituent present is in each case the same. We may thus conclude that the active substance present in polonium and radio-tellurium is a decomposition product of radium and is the sixth (or, as we shall see later, probably the seventh) member of the radium family.

The main objection, in the past, against the identity of polonium and radio-tellurium has rested on the statement of Marckwald that a very active preparation of his substance did not lose its activity to an appreciable extent in six months. Unless very special methods were employed, it would be difficult to determine with accuracy the variation of the activity for such very active material. The specimen of radio-tellurium obtained both by Meyer and Schweidler and by myself undoubtedly does lose its activity fairly rapidly.

I have recently examined more carefully the product radium D, and have found strong evidence that it is not a single product, but contains two distinct substances. The parent product, radium D, does not give out rays at all, but changes into a substance which gives out only β rays, and is half transformed in about six days. Unless observations are made on the product radium D shortly after its separation, this rapid change is likely to escape detection. The work on this subject is still in progress, but the evidence at present obtained indicates that the active deposit from the emanation, after passing through the three rapid stages, represented by radium A, B, and C, is transformed into a "rayless" product D, which changes extremely slowly. D continuously produces from itself another substance—which may for the time be termed D_1—which is transformed in the course of a few weeks and emits only β rays. This product D_1 gives rise to E (polonium).

Since the activity of D_1 reaches a maximum value a few weeks after the production of D, and will then decay at the same rate as D, the conclusion, previously arrived at, viz., that D is half transformed in about forty years, still holds good.

The view that radium D is the active constituent present in the so-called radio-lead of Hofmann has been very strongly supported by some experimental results recently obtained by Hofmann, Gonder and Wölfl (*Annal. der Physik*, vol. xv., 3, 1904).

They found that preparations of radio-lead continuously produced an α ray product, which could be separated on a bismuth plate. This active product is probably radium E, for they found it lost a large proportion of its activity in one year. They found, in addition, that by certain chemical methods another distinct product could be separated which gave out only β rays, and lost much of its activity in six weeks. This substance is probably the new radium product D_1 already referred to.

Debierne recently concluded that radio-lead and polonium were identical, and proposed that the name radio-lead should be dropped in favour of polonium. In the light of the above results, this position is not tenable. There is no doubt that the preparation of radio-lead in my possession, and also that experimented on by Hofmann, contains a distinct substance which, as the parent of polonium, has certainly as much right to a name as its offspring. The radio-active substance in "radio-lead" has no more connection with lead than Marckwald's active matter "radio-tellurium" has with tellurium. The names both arose because the active matter was initially found associated with these substances.

In order to avoid confusion, I have called the new radium product "radium D_1." If no further intermediate products of radium are brought to light, it would be simpler to call it radium E and to call the α ray product (polonium) radium F.

E. RUTHERFORD.

McGill University, Montreal, January 24.

Indian and South African Rainfalls, 1892-1902.

MR. J. R. SUTTON, of Kimberley, rendered a signal service to South African meteorology in his "Introduction to the Study of South African Rainfall" (*Trans.* S.A. Philosophical Soc., December, 1903), but when he states that south-east winds are rare on the south-east coast of South Africa, and that the rainfall of the greater part of the tableland and south-east coast comes from some northern direction (NATURE, November 3, 1904), it is difficult to follow his conclusions. Most, if not all, of those who have studied South African rainfall will, I think, agree with me that the facts do not bear this interpretation. Least of all is it the case that there has been nothing that can properly be called a drought, in the sense of Sir J. Eliot's address, within the past fifteen years in South Africa. In all the summer rainfall areas of South Africa, viz., over the bulk of the subcontinent, drought has prevailed during recent years, and in some localities it has been terribly severe.

During twenty years I have travelled over every part of South Africa except the desert areas, and I have resided continuously in those parts where there is most rain and forest. I have heard the rain and its mode of arrival discussed in every locality and from every point of view, and these facts have convinced me that the summer rains have their origin in the moist winds from the Indian Ocean. The precipitation of the moisture contained in these humid air currents is caused by barometric depressions with normal cyclonic wind circulation, and it is the winds proper to these depressions that give the appearance of rains coming from the north, north-west, west, &c.

The following gives a brief account of the various storm types. In Cape Colony storms travel from west to east at all times of the year. As one would expect, they are more regular and better developed in the south than in the north, and in Rhodesia than in the Northern Transvaal. In the north during summer they may be replaced by westward travelling tropical storms. Usually it is the secondary with its thunderstorms, a whirl within a whirl, which precipitates the greater amount of moisture. In the southern portion of the subcontinent these storms in most cases pass across from west to east with their centres to the south, and thus their wind circulation shows at first winds from the north and north-west, then from the west and south-west, and finally from the south and south-east. In summer, when the south-east trade blows on to the subcontinent with a monsoon effect, the wind remains longer in the south-east quarter, and heavy rains come frequently from the south-east or the south-west quarter The portion of the barometric depression and its accompanying circulation which brings the wind will depend on the position of the locality, but I have never known the facts not to conform more or less closely to this type of wind circulation. A range of mountains across the south-east rain-producing wind will, of course, increase the precipitation, and when once rain has started in the south-east quarter it will often continue for days with a steady south-east wind blowing like a south-west monsoon wind in India. All this takes place on the eastern side of South Africa. The rain is greatest in amount where the east wind from the Indian Ocean first strikes the highest eastern land, and the rain gradually decreases in amount until the western deserts are reached. It is generally the north-west wind which starts the precipitation, but it is quite certain notwithstanding that the humid currents do not come from the north-west. If, as Mr. Sutton has suggested, the high upper current of the north-west anti-trade were the source of South African rains, then it would be natural to suppose that the rains would be best developed on the north and western sides of South Africa, which is exactly the reverse of what actually takes place.

South Africa lies on the border of the south-east trade area. In summer South Africa, from Cape Town to the Zambezi, comes entirely under the influence of the south-east trade winds; but in winter the southern portion of